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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

In cooperation with

BUREAU OF PLANT INDUSTRY

Report of the

ALLEGHENY FOREST EXPERIMENT STATION*

CALENDAR YEAR 1937

AND PROPOSED PROGRAM 1938

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EXPERIMENT STATION

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1937

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Table of Contents

	Page No.
Intensive use of the Allegheny forest	1
Unsatisfactory condition of the forest	2
Object of the Station	3
The Station organization	3
Cooperation with other agencies	4
The Station program	5
Forest management	6
Beech-birch-maple-hemlock type	6
Silvicultural investigations	7
Mensuration investigations	9
Regeneration investigations	10
Summary	10
Oak-pine type	10
Fire protection investigations	11
Silvicultural investigations	12
Mensuration investigations	13
Regeneration investigations	14
Summary	15
Oak type	15
Mensuration investigations	16
Silvicultural investigations	16
Summary	17
Flood control surveys	17

REPORT OF THE ALLEGHENY FOREST EXPERIMENT STATION, CALENDAR YEAR 1937,

AND PROPOSED PROGRAM, 1938

Intensive Use of the Allegheny Forest

The States of Delaware, Maryland, New Jersey, and Pennsylvania, which comprise the territory of the Allegheny Forest Experiment Station, in 1935 had about 1/8 of the population of the entire United States. Most of it is concentrated in the great metropolitan area extending from northern New Jersey through Philadelphia and Camden to Wilmington, Baltimore, and Washington, D.C., and in southwestern Pennsylvania. Although it includes rich and populous farming communities as well, this territory has many hundreds of thousands of acres of "wild land" with a very small rural population.

This enormous population makes a very heavy demand on local forests for both products and services. It consumed in 1926 about 3,000,000,000 board feet of lumber. In addition to its proportionate share of the Nation's consumption of cross ties, telephone and telegraph poles, piles, paper pulp wood, veneer, chemical wood, and similar wood products, it consumes about 40 percent of all the mine timber used in the United States. Good markets for small-sized products permit of close utilization in many localities. Over 36,000,000 cords of fuel wood were cut on farms in 1925. A large part of the lumber consumption is remanufactured, Pennsylvania standing seventh among all the States in the Union in its consumption of lumber used in manufactures.

The residents of the four States, together with a part of the population of New York City, make intensive use of the forests for recreational purposes. With the development of winter as well as summer outdoor sports this use is constantly increasing. Over a million persons annually buy State hunting and fishing licenses, very largely for use in forested land. Moreover, they are few in number compared with those who hike, picnic, and camp in the woods, which in this territory have been made extremely accessible by auto and train. A tiny remnant of virgin timber in a relatively inaccessible part of Pennsylvania, remote from large cities, was recently visited by some 300,000 nature-lovers in a single year.

A third major demand made upon the forests of the Allegheny Station territory is for watershed protection. Although precipitation is normally abundant and well-distributed, water supplies for domestic and industrial use in certain sections - notably the Delaware River Basin - have caused grave public concern. More than one city is contemplating improvements in its water supplies to cost from $30,000,000 to $100,000,000. Superabundance of water, as represented by floods, is no less a problem. About 1/2 of the staggering damage done by floods in the northeastern United

States in March, 1936, was inflicted upon the Station territory, and the floods of 1937, in addition to causing great damage in western Pennsylvania, contributed seriously to the flood disasters further down the Ohio Valley. The streams of the four States generate nearly 1,000,000 horse power of electricity, and are of enormous economic importance for navigation and recreation.

Forested watersheds are certainly less subject to erosion, and are probably less productive of irregular streamflow (both high and low water) than watersheds covered by most other types of vegetation. Old World experience with the relationship of forest to streamflow, together with an increasing amount of experimental evidence obtained elsewhere in the United States, leads to the belief that properly managed forests will reduce flood crests, minimize erosion, and increase low-water flow. Although unfortunately the forest influence has not yet been quantitatively determined anywhere in the northeastern United States, forestry is today being practiced on more than one large municipal watershed in the Allegheny station territory, in the belief that it will result in more dependable supplies of water.

Unsatisfactory Condition of the Forest

The present forests of Delaware, Maryland, New Jersey, and Pennsylvania fall far short of fulfilling all the demands placed upon them. They now total 17,500,000 acres, or 40 percent of the total land area. Some authorities estimate that as much as 4,660,000 additional acres of farm land now abandoned will sooner or later return to forest. In spite of some clearing of land for agriculture, and a considerable absorption of woodland in suburban developments, the area of forest is increasing rather than decreasing.

Three major forest types are readily distinguished, and are later described. They correspond to considerable differences in climate, to variations in elevation from sea level up to 3000 feet, and to a great diversity of topography and soils. All are characterized by a great mixture of species, including both softwoods and hardwoods, which greatly complicates the problems of their management.

State forests are highly developed in Pennsylvania, and cover important areas in Maryland and New Jersey. They total about 1,750,000 acres, and an additional 500,000 acres are in State game lands and State, county, or municipal parks. The one National Forest in the station territory embraces 440,000 acres in northwestern Pennsylvania. Of the private forest land, 5,520,000 acres are owned by farmers, and the remainder by corporations or non-resident individuals.

The condition of millions of acres of this forest land is unsatisfactory. The virgin forests have practically disappeared. Well over 2,000,000 acres of cut-over land bear only scrub oak, aspen, and fire cherry. The condition of none of the second growth equals that of the intensively managed forests of central Europe. This is in spite of a long fight on the part of the State forestry departments in all four States -

three of the State forest services are at least as old as the Federal service - to protect forest lands against fire, insects, and disease, to place in public ownership all areas which private owners cannot economically manage in the public interest, and to encourage private land owners in the practice of forestry. The lands in public ownership have been greatly improved by intensive fire protection, and a creditable program of forest practice is being carried out by a few small and large forest owners. Nevertheless, only a small percentage of the 350,000 acres of private land that are logged over in a normal year are left, except by chance, in a condition to produce an ensuing crop of timber as good as or better than that just removed. In entire counties having a peculiarly high fire hazard the percentage of forest land annually burned over has averaged over 3 percent, even in recent years. The 1936-1937 (fiscal year) expenditure by the four States for forest activities was $925,000, or about 1/8 of the total expenditure of all of the States engaging in this sort of work. Prior to the depression these State Appropriations were $1,930,000, or more than 1/4 of the total for the States.

Object of the Station

Located in a region half of which is or will be forested, and in which a great population places heavy demands upon the forest for wood, for recreation, and for watershed protection, the Allegheny Forest Experiment Station is a Federal contribution to the solution of acute forest problems common to four States. The object of the Station is to supply to practicing foresters and forest land owners the technical information they need to make the Allegheny forests serve the inhabitants of this territory to the fullest possible extent. In undertaking this service, the Station understands that whereas forests outside its territory may supply wood in some of its forms more economically than local forests, in other forms they may not, and that only in a very limited way can the outside forests serve the people of the four States as recreation grounds and as protectors of watersheds.

The Station Organization

The Station has been organized with the main thought of furnishing technical information to the entire territory, regardless of ownership, although as another Federal agency it has emphasized service to the one National Forest in its territory. Its headquarters are in Philadelphia, centrally located to the four States which the Station serves, and on the campus of the University of Pennsylvania, a traditional friend of forestry. Members of the technical staff have their year-long residence in or near Philadelphia, which, third in population among the cities of the United States, offers both scientific and cultural stimulation of a very high order.

Field work is conducted from branch stations located in the woods and equipped with simple laboratory facilities and living quarters for visiting members of the staff. It is our ambition to make these facilities available, so far as possible, to cooperating scientists. The system of branch stations is expected to cover eventually all of the major variations in natural and economic conditions within the three main forest types.

These should not exceed 8 or 10. Five have so far been established, or are under serious consideration.

The Lebanon Branch Station has an experimental forest of 525 acres on the Lebanon State Forest in southern New Jersey. This Branch serves a forested area of about one and a half million acres in which pitch and shortleaf pine and white and chestnut oaks are the dominant species.

The Kane Branch Station, 7 miles south of Kane, Pa., within the Allegheny National Forest in northwestern Pennsylvania, has an experimental forest of nearly 1800 acres, and the use of several other experimental tracts, including the 3500-acre tract of virgin hemlock and hardwoods on the headwaters of Tionesta Creek, bought by the Government at the original suggestion of the Experiment Station. The Kane Experimental Forest illustrates the widely-varying mixtures of second-growth beech, birches, maples, and black cherry on non-glaciated soils in the northern hardwood type; hemlock, widely distributed in the virgin forest of this territory, is also represented.

About 1800 acres of a much larger tract bought by the Department of Agriculture for a research center near Beltsville, Md., have been assigned to us as an experimental forest. Although in the Coastal Plain, this Branch is close to the Fall Line; the characteristic species are Virginia pine, and a variety of upland oaks characteristic of the Piedmont Plateau.

About 1800 acres in Standing Stone Valley, Huntingdon County, Pa., are being purchased by the Farm Security Administration, and developed for our use. Adjacent areas purchased by the Administration will be used by the forestry and other departments of Pennsylvania State College. This forest in the oak type includes stands of Virginia and white pine on old fields, and stands of white pine mixed with a wide variety of upland oaks typical of elevations above 1000 feet.

The Farm Security Administration will eventually turn over to our use another tract of about 1000 acres on the Eastern Short of Maryland, just south of the Delaware-Maryland line. This portion of the Coastal Plain is much more highly developed for agriculture than southern New Jersey or the western shore of Maryland, and the forests are dominated by loblolly pine and sweet gum.

At the first four of these branches field buildings of varying adequacy have been erected, and an intensive system of fire protection has been established under a resident ranger or caretaker. The older experimental forests have been cruised, and the soils mapped; meteorological and phenological records are kept. Extensive sanitation cuttings, to prevent wood rots from multiplying in wounds caused by a catastrophic glaze storm in 1936, are in progress on the Kane Forest.

Cooperation with Other Agencies

Although the Station's function is above all else research, it cannot select an appropriate program, and disseminate its findings effectively, without reasonable participation not only in the general forestry move-

ment, but also in related movements, as for example wildlife conservation, water conservation, and public movements toward good government in the broadest sense, such as promotion of civil service.

Cooperation with all forestry agencies in the Station territory, and through them with the owners of forest lands, has therefore been stressed as vital to the success of the Station. The Station itself is a cooperative enterprise within the Department of Agriculture; the Bureau of Plant Industry since 1929 has stationed two or more forest pathologists at Philadelphia. These men share both the headquarters and field facilities of the Forest Service.

The administrative organization of the Forest Service has, as already indicated, put at our disposal experimental areas within the Allegheny National Forest, and contributes substantially to the construction and upkeep of roads, maintenance of structures, and protection against fire. Contact and cooperation with the State forest services are maintained on the ground at our branch stations, one of which is actually located on a State forest, and all of which are not far distant from State forests. Close cooperation with the Forestry Department of Pennsylvania State College, the only forest school in the Station territory, is anticipated at the Standing Stone Branch Station, to which location we were invited by the College. This cooperation will include both administration and research, the latter under a carefully coordinated program.

Cooperation with forestry organizations, institutions interested in botanical sciences fundamental to forestry, forest land owners, forest industries, and forest conservationists in general is maintained through the Allegheny Forest Research Advisory Council. This body of 22 men appointed by the Secretary of Agriculture meets twice a year, once at Philadelphia and once at a Branch Station, and has also set up a number of working committees. The functions of the Council are to correlate, coordinate, and to stimulate an adequate program of forest research in the Station territory. It is a purely advisory body.

The outstanding examples of cooperation during 1937 have been that growing out of the Flood Control Act of 1936, and the activities of the National Resources Committee. Under the Flood Control Act the Station, representing the Department of Agriculture, has worked very satisfactorily with the Army Engineers. The Station Director has served as a member or as chairman of watershed committees, reporting to the Water Resources Committee of the National Resources Committee, on the major streams of the Station territory. The Soil Conservation Service and the Bureau of Agricultural Economics, also of the Department of Agriculture, have worked most cordially with the Forest Service on these committees, and the local contacts have been illuminating and stimulating.

The Station Program

The forest problems of Delaware, Maryland, New Jersey, and Pennsylvania, are numerous and diverse, and research is essential to the satisfactory solution of all. Some of these problems are biological, others economic. Broadly speaking, the biological problems are two: (1) the

protection, improvement, and perpetuation of the existing forests, and (2) the restoration of denuded areas to full usefulness. By full usefulness is meant their usefulness for wood production, recreation, and watershed protection. The economic problems deal with the business aspect of forestry - the balance of cost against return - and include proper land use, land ownership, markets for forest products, etc.

The selection from the many urgent problems of forestry in the Station territory of a few problems on which to work immediately depends on their intrinsic importance, their immediate urgency, the progress already made toward their solution, and some special considerations. Federal research on problems of strictly local importance, and on problems which are of only academic interest because the economic conditions of the present or any immediate future preclude their solution, is indefensible. If sufficient work has already been done to furnish usable answers to certain problems, or if other agencies than the Federal government are on the way toward their satisfactory solution, these problems are to be avoided.

Special considerations always dictate a certain amount of departure from the basis of choice already described. The fact that, other things being equal, the administrative branch of the Forest Service and other Federal agencies are those most likely to turn for information to a Federal experiment station, justifies emphasis by the Station on their problems. Again, the fact that its so-called headquarters forest is located in southern New Jersey has inevitably lead the Station to rate the many forest problems of that denuded region above those of other regions having a better growing stock and a higher potential growth rate.

The program of the Allegheny Station, as dictated by the foregoing considerations, follows. It has been currently revised in the light of new facts and new conditions, such as the establishment in 1933 of the Civilian Conservation Corps, and the growth in importance in recent years of the Federal work in State and private forestry. The work in Forest Management is discussed by types, instead of by individual projects as heretofore. Organization of this work by types at a Station of our present size appears preferable to organization by lines of work, and better adapted to cooperation with outside agencies.

Forest Management

Beech-birch-maple-hemlock type

The beech-birch-maple-hemlock type, which in the virgin forest included also large areas of white pine, covers about 4-1/2 million acres of forest land on the high plateau of northern Pennsylvania and western Maryland. Climatic, soil, and market conditions make this a non-agricultural area which was once the chief source of raw material for a Pennsylvania lumber industry exceeding that of any State. It is still the source of most of the lumber produced in the Station territory, and its extensive paper pulp and destructive distillation industries furnish excellent markets for small material, permitting close utilization. As the home of an abundant and diversified wild life the northern hardwood-hemlock forest attracts hunters, fishermen, and out-of-doors enthusiasts

in large numbers. Covering the mountains and plateaus of the headwaters of such major streams as the Delaware, Susquehanna, and Ohio rivers, it is of outstanding importance in watershed management for flood control, reduction of erosion, hydroelectric power, municipal water supply, and navigation. The one National Forest in the Station territory, and several State Forests, are located here. Farm woodlands are relatively unimportant. The bulk of the forest is in industrial ownership, with here and there a corporate owner taking a substantial interest in forest management. Considerable areas are owned or leased by hunting and fishing clubs.

Practically the whole forest has now been logged once, and cutting for smaller products has begun in the second growth. Although the second growth is comparatively satisfactory over great areas, about 500,000 acres have been cut so clean, and so thoroughly devastated by fire in the logging slash, that aspen and fire cherry have taken the place of the commercial species.

Chiefly because of the importance of the beech-birch-maple-hemlock type for wood production, for recreation, and for watershed influences, but partly also because the one National Forest of our territory is almost wholely in this type, the Allegheny Station has concentrated here the greater part of its research. Very little research had been done in the type prior to the establishment of the Station. A bulletin on the type has been published by the Pennsylvania Department of Forests and Waters. Funds and authorization have been available for work in forest management only.

Silvicultural investigations. How to harvest the present forest crop, while insuring both the quantity and quality of the regrowth, is the major silvicultural problem of the type. Most commercial cuttings today cause deterioration of the forest. Second in importance is the improvement, through intermediate cuttings not ordinarily resulting in reproduction, of the immature second growth which covers by far the greater part of the type. On publicly-owned land timber stand improvement, even in young stands, has become possible through the advent of the CCC, but on private land must generally wait until the trees to be removed are large enough for pulpwood, chemical wood, or fuel.

Ecology and silvics. Fundamental studies in the ecology and silvics of the type have been stressed. Future management for wood production may be based largely on one species, or group of species, management for recreation on another, and management for watershed protection conceivably on a third. The fundamental approach, although seemingly devious, in the end may well prove the shortest avenue to the practical information needed in management for all three purposes. It has taken the form chiefly of rather careful study of the few remnants of virgin timber. Samples of the virgin forest tallied over a wide area in northern Pennsylvania, from Sullivan County west, will supplement data from very intensively-studied samples in restricted areas, such as the virgin hemlock and hardwoods on East Tionesta Creek, and the virgin white pine of Hearts Content and Cook Forest. Careful analysis of the composition, age-relationships, and other phenomena observable in these samples of both the climax forest and the earlier stages of succession, we expect will furnish better guides to long-term human management of the future forests than will silvical information obtained in second or third-growth stands, where human interference tends to obscure the operation of natural factors. Other

ecological studies have included observations since 1932 at four weather stations, in as many different stand conditions, in the Kane Experimental Forest; in the same Forest a study on fenced and unfenced areas of the effects of deer and rabbit damage to natural reproduction; and, in close cooperation with forest pathologists, studies of the common defects of important species. A severe glaze storm which visited the Kane Experimental Forest in March, 1936, gave an opportunity to study the resistance of the various species to this type of catastrophic injury.

Chief progress in the fundamental study during 1937 was the publication of an article, "Why Timber Stand Improvement?", on defects in second-growth stands, and two articles on glaze damage. Age and other data from the plots established before cutting of virgin timber in East Tionesta Creek were completed and are now ready for analysis. The major undertaking of the Station during 1938 in the northern hardwoods-hemlock type will be the preparation from these, and our other fundamental data, of a technical bulletin on the silvics of this type.

Final cuttings. The two very practical problems of the beech-birch-maple-hemlock type already described - reproduction following final cuttings, and timber stand improvement - have received about equal attention with the ecological studies. Work on final cuttings has been largely confined to a series of plots, taken over from the National Forest on one of its early timber sales. This sale on Little Arnot Creek, was in a stand which followed a heavy cutting 60 years before in virgin timber. A few small hemlocks, and a considerable stand of hardwoods, were left in the original cutting, and have been supplemented by fine young second-growth. Five-acre sample plots were laid out in 1928 in a clear cutting, in a cutting for sawlogs only, and in a so-called selection cutting which aimed to remove defective and slow-growing trees and retain for future growth the more vigorous and valuable individuals. Among the facts already evident are the slow growth of the advance understory, the low survival of the current year's seedlings, and the rapid growth of seedling sprouts and stump sprouts. The second 5-year remeasurement was made during 1937.

During the same year advantage was taken of the sanitation cuttings in the glaze-damaged timber in the Kane Experimental Forest to study what amounts to the second cutting under a shelterwood system of reproduction in an old-growth stand, and a clear cutting in immature second growth. In 1938 the data from the Little Arnot plots will be summarized and examined for worth-while, even though local, information. Some additional data will be obtained on the plots established in 1937, and establishment reports prepared. Obviously no satisfactory answer to the very many problems of obtaining reproduction following cutting can be obtained from these few plots. Commercial sales of sawlogs are anticipated in increasing numbers in the Allegheny National Forest, and there is great need for a comprehensive study of silvicultural methods applicable to them and cuttings on private land. Man power is lacking to begin this work before 1939.

Timber stand improvement. Timber stand improvement studies now cover nearly 30 acres in the Kane Experimental Forest. Experimental thinnings were first made in two 40-year-old stands, the main objective being to compare the effect of removing not less than 10 cords of merchantable wood (at that time the economic minimum) per acre with that of a cutting purely for the benefit of the existing stand. The silvicultural cutting,

so-called, was found to remove more than 10 cords per acre; so that growth following only one degree of cutting is compared with that in uncut stands. Some reproduction will also take place. It was clearly evident from the work done in these stands that an alarmingly high percentage of individuals, almost regardless of species, were diseased, scarred, or misshapen. Great difficulty was found in locating a sufficient number of crop trees to produce a full stand of future sawlogs.

Attention was therefore turned to younger stands, to which improvement work would not come too late. With CCC labor available for large-scale timber stand improvement work on public lands, a series of weeding plots was established in 1936 in stands 13 to 19 years of age. An endeavor was made to select in each of these stands 200 to 300 crop trees per acre and to give them varying degrees of release from their competitors. Time-costs were kept of the work. It became clearly apparent in the course of these weedings that still earlier work in second-growth stands is advisable, before such inferior species as aspen and fire cherry seriously stunt the crop trees; and that in third-growth stands, where sprouts are too little supplemented by either advance or subsequent seedling reproduction, crop trees may be very scarce.

During 1937 additional data from several third-growth stands were the basis for a published article comparing the effect of clear cutting old-growth and immature second-growth stands, which differ markedly in the abundance of advance reproduction. Other field work during 1937 included exploratory treatments of black cherry stump sprouts, and pruning as related to pathology and structural defect in selected crop trees of five species of hardwoods. During 1938 mowing of advance seedling growth as a stand improvement measure will be tested in the shelterwood cutting described under final cuttings, and establishment reports will be prepared for all 1937 field work. Reduction in the CCC effort might shift the emphasis in future timber stand improvement work to private land managed on short rotations for pulpwood and chemical wood. Here periodic cuttings, beginning as soon as the stands have some merchantable timber, hold forth promise of an economic return. However, present funds do not permit extension of the Station work into the problems of the private landowner.

Mensuration investigations. The Station has never undertaken formal studies in the beech-birch-maple-hemlock type. As an incident to other work, a volume table for black cherry was constructed in 1929, and in 1937 sufficient black and yellow birches were measured in the Kane Experimental Forest for a volume table which will be constructed in 1938. There is a need for local volume tables for the remaining common species, particularly small trees, in cubic feet for scientific and administrative use. A study of converting factors from cubic feet to cords was made in 1928 by the Station at the request of the Allegheny National Forest, and with its help. There is immediate need among Federal and private foresters for data on the volume of wood contained in the tops of sawlog trees. Published information on yield for the northern hardwood-hemlock type in the Station territory is confined to tables in cubic feet prepared by the Pennsylvania Department of Forests and Waters. A few permanent yield plots were established in the Kane Forest, and have been remeasured once. Comprehensive yield and stand tables are needed for various mixtures of the common species similar to tables now available for upland oaks.

Regeneration investigations. In 1936 the Experiment Station cooperated with the Allegheny National Forest in a survey of several thousand acres of older plantations in the Allegheny National Forest and on the holdings of a pulp company adjacent. A report prepared in 1937 recommended spruce, red pine, and Scotch pine for progressively drier sites, and among the hardwoods, oak; white ash, larch, and white pine had not been successful. The planting program of the Allegheny National Forest is 42 percent of that of the entire Eastern Region, and in 1938 the Forest will plant 1,700,000 seedlings. In cooperation with the Lake States Experiment Station, which is studying seed source in its influence on survival and behavior of planted red pine in the eastern United States, in 1937 we set out a 4-1/2-acre plantation of 50 different strains of this species. A small test of heating and pulping treatments for ripe and unripe seed of black cherry followed a similar test of seed storage conditions.

The large part which reforestation will play in the proposed five-year program of the CCC in the Allegheny National Forest (27,400 man-days, as compared to 24,562 man-days on timber stand improvement and 28,500 man-days on fire) was the basis for our undertaking, on CCC research funds, a special planting study largely on the Allegheny National Forest. Work during 1937 included some further analysis of the data obtained on the studies already described, and in 1938 will consist chiefly of tests of sizes and classes of stock of the more promising species. A special conference with the State and Federal men directing CCC planting activities will determine details and procedures.

Summary. Chief accomplishments in this type during 1937 are publication of timely articles on timber stand improvement, glaze damage, and the effects of clear cutting, and cooperation in an illuminating report on planting in the Allegheny National Forest. During 1938 a Departmental circular will be prepared on the silvics of the beech-birch-maple-hemlock type.

Oak-pine

The oak-pine type covers about 2,800,000 acres of the sandy, relatively level Coastal Plain in the territory of the Allegheny Station. There are three distinct subdivisions, each with its own biological and economic problems: the pitch pine-oak forest of southern New Jersey, the loblolly pine-sweet gum forest of southern Delaware and the Eastern Shore of Maryland, and the Virginia pine-oak forest of southern Maryland, west of Chesapeake Bay.

In south Jersey about 1,400,000 acres of nearly continuous woodland probably lie closer to great centers of population than any forest of like area in the World; within 75 miles of its centre live 12,000,000 people in 4 States. Even in its present degraded condition, resulting from at least a century of over-cutting and periodic fires, it furnishes recreation to hunters, fishermen, and outdoor enthusiasts in large numbers; produces some wood of high technical quality; fills a considerable local demand for fuel; and is believed by some to exercise a favorable influence on south Jersey's small but extremely valuable streams. If it can be restored to full productivity by effective fire protection and

intensive silvicultural management, the south Jersey forest has great promise. A substantial part of the Station's research has been done here. The New Jersey forest service also conducts some investigations.

The Eastern Shore is a region of intensive agriculture, which has created a strong local demand for forest products, and piling and mine props have at times been heavily exported. Loblolly pine is probably the fastest growing conifer in the Station territory, and sweet gum is also of very rapid growth. The large percentage of the forest in detached farm woodlands, many of them on old fields, has facilitated fire protection, and the condition of the forest of 825,000 acres is generally good. Both the Maryland Forest Service and the Allegheny Station have made substantial studies here.

Southern Maryland, although a promising recreation ground for Washington, Baltimore, and Annapolis, has suffered from fires and heavy commercial cutting. Research by State and Federal agencies has been limited.

Fire protection investigations. Fire protection is the overwhelmingly important problem in one subdivision of the Coastal Plain, and is important in another.

Southern New Jersey is notorious throughout the northeastern United States for periodic extensive fires. In 1936 46,000 acres burned in a single fire. Although some conditions, notably the levelness of the terrain, are very favorable to successful fire protection in south Jersey, they are offset by the heavy fire risks from an extremely large transient population, and by such natural hazards as high winds and inflammable fuels. Following the disastrous fire season of 1930 we made a small study of fire damage, resulting in the first published data on fire resistance of the important species. In 1936 the State Forest Service, in charge of fire protection on the 40,000 acres of State Forests in southern New Jersey, asked our cooperation in a study of the silvicultural and other effects of "controlled burning". In recent years the percentage of burn on the State Forests has been held to 1/3 of that on privately owned land by the liberal use of carefully-burned "safety strips" and by intensive organization for fire fighting. The CCC has been extensively used in this work.

During 1937 this cooperative study has absorbed the major portion of the Station's effort in south Jersey and was supplemented by our observation of other "controlled" burns outside of the main experimental area of 80 acres. Damage to the existing stands and the effect of fire on current reproduction of pine are observed by the Station, and cost records are kept by the State. Under a cooperative arrangement between the State Forest Service and the New Jersey Agricultural Experiment Station the long-term effect of fire on soils is being observed by Dr. Joffe of the Agricultural Station. Early in 1938 an article will be prepared from the first-year data on damage from all of the experimental areas; about 4 acres of plots in firebreaks intended for annual burning will be made permanent, and current damage recorded.

In addition to these studies of the effects of fire, a study of fire behavior, earlier undertaken in cooperation with Region 7, was continued on CCC research funds in 1937. During the fiscal year 1936 42 percent of the CCC effort in New Jersey had been in fire protection, and

in the fiscal year 1937, 40 percent; CCC labor was used both in pre-suppression, such as the preparation of safety strips, and in actual fire fighting. Data for 1935, 1936, and 1937 on rate of spread of fires, and related items, were taken from the south Jersey fire records and prepared for machine analysis. This work was done in close cooperation with the acting State Fire Warden late in the year. During 1938 additional data on the 1937 fires will be obtained locally from the fire wardens, and studies will be made of going fires during the spring fire season. Emphasis will be placed on fire behavior (i.e. rate of spread) as affected by fuel type, weather, and fire control measures. By July 1 the data will be summarized, analyzed, and any justifiable conclusions drawn for use of the local CCC, and possibly for general publication.

Intensive protection of any forest area can be justified only on a showing of high fire losses per acre. The monetary values assigned by the State authorities to losses in the denuded forests of south Jersey have been questioned. Yet reduction in expenditures for fire protection, predicated on any lower evaluation of damage, would certainly intensify the present unsatisfactory situation. There is therefore need for a really comprehensive study of fire damage not only to forest products, but also to the so-called intangibles of recreation and watershed values inherent in a region which is adjacent to great populations and in which water resources, both above and below ground, are extremely precious. The Experiment Station lacks the resources to undertake the first part of this study, and lacks both the resources and authorization to undertake the second. Other fire studies urgently needed here, and to some extent in southern Maryland, are of equipment and methods of organization for better fire protection.

Silvicultural investigations. The silvicultural problems of the oak-pine type have received some attention from the State forest services, although the substantial Maryland publication on loblolly pine contains more data on mensuration than silviculture. The Maryland Forest Service has considerable unpublished data on Virginia pine. New Jersey's publications report some extremely intensive stand improvement work in southern white cedar, and less intensive studies of oak and pine.

Natural regeneration. In southern New Jersey the Allegheny Station has studied reproduction by seed and sprout on a considerable scale. Because of the overwhelming importance of sprouts in the present forest, coppice of the principal hardwoods under varying degrees of competition has been observed on two areas, and a fundamental study of root behavior of chestnut oaks of seedling origin as compared with sprouts was early begun. The root study was discontinued because of the labor involved in root excavation even in sandy soils; a less intensive study of the root system of pitch pine, from seedlings to mature trees, was reported in the Journal of Agricultural Research. In 1937 a paper on sprouting of oak was accepted for publication.

Rehabilitation of the generally ragged sprout stands of oak and pine in southern New Jersey must eventually be based on the introduction of a satisfactory number of seedlings. Danger from decay, failure of some stumps in each generation to sprout, and a tendency of sprouts ultimately to become prostrate, preclude continued reliance on sprouts. The

Station's 8-year study of seedling reproduction of oak, particularly chestnut oak, was summarized for publication during 1937. It is based on detailed observation of over 7,000 seedlings in artificially-seeded beds, and over 2,000 natural seedlings. Conclusions were largely negative; although we cannot supply directions for obtaining a satisfactory seedling reproduction of oak, we can point out a number of conditions which militate against germination and survival. No further work will be done with the oaks until satisfactory progress has been made in the study of pine seedling reproduction. In 1936, when a fair crop of shortleaf pine seed was anticipated, various mechanical methods of modifying the seed bed were tried in an area well supplied with seed trees. Observations of natural reproduction from seed on this and two other areas, described in connection with other experiments, will be continued during 1938, and preliminary information will be published if justified. Artificial seeding will be employed on one of these areas to supplement the natural seed fall, and screens will be used to protect some of the seed against birds and animals. Phenological observations of the principal species, particularly their seed production, will be continued.

Stand improvement. In 1935 stand improvement work of the CCC on the Lebanon State Forest in south Jersey was the starting point for a study of several degrees of thinning in a sapling stand of sprout oak and a few pines. Thinning of sprout clumps and elimination of scrub oak should improve even open stands such as this. It is fairly evident from the '36-'37 reproduction tallies that encouragement of pine reproduction, one of the original objectives of this improvement cutting, cannot be accomplished without some treatment of the seedbed. The plots will be remeasured in 1940.

At the request of the Maryland Forest Service a beginning was made during 1937, on CCC research funds, in thinning and pruning studies of Virginia pine in southern Maryland. Guides to desirable spacing were obtained by preliminary studies in our Research Centre Experimental Forest near Beltsville. In 1938 demonstrations will be made of these practices on the Cedarville State Forest, and tentative recommendations will be prepared by July 1 for CCC use.

Silvicultural studies will remain secondary in importance to fire studies in south Jersey. This in no sense implies that south Jersey's silvicultural problems can be solved by fire protection alone; in no portion of the Station territory, except perhaps the anthracite coal region, would this be less true. The need for more reliable information on stand improvement practices is much more immediate, however, in loblolly pine and associated species on the Eastern Shore, where economic and natural conditions favor intensive silviculture; it can be met in part by the Station's analysis of existing long-term records described under the next heading. A systematic round-up of available information on Virginia pine should precede any long-term studies of it in southern Maryland, which rank second in urgency to the loblolly study.

Mensuration investigations. "Loblolly Pine in Maryland", published by the State Forest Service, presents comprehensive volume and normal yield tables for that species. Maryland also has unpublished data on Virginia pine. The Appalachian Station in 1937 extended its study of

empirical yield of this pine into the Allegheny Station territory.

The series of permanent sample plots of loblolly pine established by the U. S. Forest Service on the Eastern Shore of Maryland in 1906 has been remeasured every 5 years since, the last two times by the Allegheny Station. Although the plots were located on private land and have gradually decreased in number with cutting or culling of the stands, the records represent some of the most valuable long-term data on growth and development of stands available in the United States. They contributed to the State yield tables above mentioned, and were used by the Station in two fundamental studies of diameter distribution and of density-basal area relationships to growth, the results of which were published in '34-'35. In 1938 the most recent remeasurements will be incorporated in the long-term record, which will then be thoroughly reviewed and made the basis for recommending practical timber stand improvement measures in loblolly pine.

Provided the Appalachian Station's information on Virginia pine yields can be localized satisfactorily for use in southern Maryland, the oak-pine mensuration study next in importance is the compilation of a very considerable amount, in the aggregate, of data on growth from permanent yield plots and similar sources. Both State and Station records would be drawn upon, and combined with data on mortality should give a reasonable basis for badly needed fire damage appraisals.

Regeneration investigations. Almost the only studies of seeding and planting in the oak-pine type have been made by the Station.

The New Jersey Forest Service has for many years interplanted conifers in clear-cut oak stands in the south Jersey State Forests, in an effort to convert them to a high coniferous forest with an understory of oak coppice. An experimental planting of several species of pine was made by the Station on about 40 acres in 1930-33; early results have been published, and indicate some superiority of the native species. A small trial of hardwood planting is also under way.

In 1937 the Station's mycorrhiza project, begun as a fundamental study jointly undertaken by the Forest Service and Bureau of Plant Industry, but for several years carried by the B.P.I. alone, reached the stage of practical tests of nursery inoculation. A nursery site was cleared in the Lebanon Experimental Forest and 48 small beds were sown with pitch pine. Among whatever beneficial effects mycorrhiza-forming soil fungi may have on their "host" is presumed to be their conversion of organic nutrients into a form more readily assimilable by the higher plant. Some of the beds were therefore fertilized with organic, others with inorganic, fertilizers, and half of each group was inoculated with a soil fungus known to produce mycorrhizae on the roots of pitch pine. Other beds received no fertilizer, but were inoculated with soil fungi, including one mycorrhiza-former and two non-mycorrhizal and non-parasitic. At intervals during the summer a sample of seedlings from every bed was removed hydraulically, the root systems carefully measured, cultures made to identify any fungi affecting them, and specimens preserved for mycorrhizal counts. An illness of Dr. Doak has delayed the necessary follow-up in the laboratory, but the Forest Service has completed statistical summaries of all measure-

ments to date. During 1938 the two bureaus will cooperate in the examination of a single sample of the seedlings, obtained at the end of the growing season.

Planting problems in south Jersey are too local to be given high priority on the Station program, and elsewhere in the oak-pine type are not as important as several other subjects for research. The mycorrhiza research, on the other hand, is of first importance in a Station territory where artificial reforestation has been, at least until recently, the most important silvicultural operation - the total area planted being now over 250,000 acres - and where early mortality has been about 65 percent in both public and private plantings. As soon as methods have been more thoroughly worked out from the Lebanon experiments in the oak-pine type the nursery inoculations should be extended to species and nurseries of the two other forest types.

Summary. During 1937 studies of the effect of fires in south Jersey were greatly intensified in close cooperation with the State Forest Service and the CCC. The results of 8 years' study of seedling reproduction of oak in the same territory were submitted for publication, and a nursery test was begun of the effect of inoculating pitch pine with mycorrhizal and other soil fungi, in combination with various fertilizers. In 1938 CCC research funds will be used to complete brief studies of fire behavior in south Jersey, and of timber stand improvement methods in southern Maryland. Long-term data on loblolly pine on the Eastern Shore will be used in framing practical recommendations for timber stand improvement. A problem analysis for the whole type will be made.

Oak type

The oak type (chestnut-chestnut oak-yellow poplar in Zon and Shantz' classification) covers over 10,000,000 acres in the Station territory, and a wide range of climatic, physiographic, and economic conditions. In the past it supplied the iron industry with charcoal, and is today the source of most of the huge quantities of mine timbers consumed by the local coal and other mining industries. Other important products are cross ties, fuelwood, pulpwood, fence posts, piles; its output of lumber is relatively small. Some of the most disastrous floods in the Station territory have been caused by tributaries of the Delaware, Susquehanna, and Ohio Rivers originating chiefly in this type. As watershed cover its condition seriously affects erosion, hydroelectric power, municipal water supply, and navigation. Isolated farm woodlands predominate in the broader valleys, but in the more mountainous sections the farmers' holdings extend to the ridges, where they form continuous forest. The bulk of the State Forests are in this type. Large tracts are owned by coal companies, a few of which are interested in their management for permanent forest production.

Only an occasional small tract of virgin timber remains. Extensive areas are now being logged clean for the second or third time; others have been repeatedly culled. Estimates of the acreage dominated by scrub oak have been placed as high as 3,000,000; fire in logging slash is largely responsible for this condition. Even the best of the second growth has not fully recovered from the killing of all merchantable chestnut by the

blight, but some excellent stands exist, mostly in farm woodlands and in State Forests. Planting of abandoned farm lands has been extensive.

The Pennsylvania State College and the State Forest Services have concentrated their research on the problems of this type, particularly nursery and planting practices, although their published material has dealt chiefly with volume and growth. In order to avoid duplication, and to prevent diffusion of its own effort, the Station has largely confined its work in the type to mensuration, and a very recent test of pruning and thinning in a plantation.

Mensuration investigations. Volume and yield tables for oak have been published by both the College and the Department of Forests and Waters in Pennsylvania, and the latter agency has published similar tables for pitch pine.

In 1931 the Station cooperated with Pennsylvania State College in a publication on tree volumes expressed in mine prop units.

In 1937 appeared a Departmental bulletin prepared some years before at the Allegheny Station but delayed in printing; it presented volume, normal yield, and stand tables for upland oaks in the entire eastern United States. Most of the field data had been obtained by the Appalachian and Central States Stations. In 1937 the Station published local volume tables in cubic feet for planted white pine and tulip poplar. In 1938 we will prepare a short article on local studies of tree volumes, and will endeavor to work out, in cooperation with Region 7 in a proposed sustained yield unit on private land in western Pennsylvania, practical methods of applying the growth data obtained in well-stocked, even-aged stands to less regular stands. A major need is for means of growth prediction in the latter stands. In a region where markets are normally good for products of all sizes, another need is for studies of the cost of growing these products in relation to probable returns. The Station has neither funds nor authorization for such studies at present.

Silvicultural investigations. A Pennsylvania Department of Forests and Waters bulletin on pitch pine, dealing secondarily with silvicultural management, presents some research results; other State publications on this subject are for extension use and generally lack much research basis.

Pennsylvania State College collaborated with the Station in a publication on some effects of the 1930 drought in this type. In 1937 CCC research funds were used in a study of thinning and pruning methods in a plantation of white pine and tulip poplar on the Baltimore city watershed. The thinnings were handled on a demonstration basis for the CCC, which did the actual cutting on the experimental area and then thinned the remainder of the stand. The pruning study compared, for a great variety of tools and several pruning methods, time-costs, damage to tree, and danger and fatigue to workers. The results were prepared for publication. In 1938 the thinning data will be analyzed for at least CCC use.

There is the most pressing need for research in silviculture, as well as in artificial regeneration and fire protection, in the oak type.

A problem analysis for each of several natural and economic subdivisions of the type is required before priorities can be assigned to studies of timber stand improvement, to a critical survey of the very extensive plantations, and to fire protection investigations in such heavily-burned areas as the anthracite coal fields, all of which are known to be of great importance. This analysis cannot be attempted with present funds for at least a year.

Summary. In 1937 thinning and pruning in a plantation of white pine and tulip poplar were studied, and a paper on pruning tools and methods was written for publication. Our 1938 plans include a report to the CCC on the 1937 thinning demonstration, and a trial, if desired by the administrative branch of the Forest Service, of the application of present growth data to practical problems of sustained yield management.

Flood Control Surveys

The Flood Control Acts of 1936 and 1937 authorized and directed the Secretary of Agriculture to make "preliminary examinations and surveys" for runoff, water-flow retardation, and soil erosion prevention on certain watersheds. To handle these surveys the Department of Agriculture set up Field Committees drawn from the Forest Experiment Stations, and from the regional offices of the Soil Conservation Service and the Bureau of Agricultural Economics. Primary responsibility for preliminary examinations and surveys is delegated to the chairman of the committee in each area. The Station's representative is chairman of Committee 2, covering the Delaware, Passaic, Raritan, and some minor rivers, and we are represented on Committee 3b, covering the remainder of the Station territory, with the exception of the Potomac River watershed. The committee 2 and 3b areas include parts of West Virginia, Ohio, and New York, not within the Station territory.

The Station began its participation in the flood control surveys late in September, 1937; only preliminary investigations, and reconnaissance of the Lehigh River watershed, were accomplished before the close of the year.

The purpose of the preliminary examinations is to determine, from available data and information, the size of the flood problem, the relationship between runoff and current vegetal cover conditions within the watershed, and the significance of soil erosion to streamflow and silting. On the basis of these reports the committee will recommend for or against a detailed survey. Committee 2 will submit its first preliminary report - on the Lehigh River, a tributary of the Delaware River draining a portion of the badly-denuded anthracite coal region - in April, and will then begin work on the Passaic watershed. Committee 3b will report a little earlier on the Youghiogheny River, an important tributary joining the Monongahela River just above Pittsburgh, and will follow with a preliminary report on the Kiskiminitas River, also in southwestern Pennsylvania.

No detailed survey within the Station territory has yet been approved

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by the Departmental Coordinating Committee, but it is anticipated that because of the major flood problem existing here at least one such survey will be approved in 1938. Detailed surveys will go much further than the preliminary surveys into an analysis of the watershed problems and will correlate them with completed, planned, or projected improvements for the control and use of the water resources. Based on the best available information on damages, remedial measures will be proposed, the cost of which will be justified by the benefits obtained.

RS-AL
Mr-1

April 6, 1938

ECOLOGY AND SILVICS, BEECH-BIRCH-MAPLE-HEMLOCK

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Forest Management

3. FUNCTIONAL PROJECT: Silviculture, Beech-Birch-Maple-Hemlock

4. LINE PROJECT: Ecology and Silvics

5. PURPOSE OF WORK:
To determine the silvical characters of tree species, and the physiological and environmental factors affecting untreated stands and reproduction, in the beech-birch-maple-hemlock type. Field studies may be supplemented by greenhouse and laboratory experiments.

6. REVIEW OF PAST WORK:
In 1928-30 strip cruises were run in recently-logged virgin and second-growth stands in the northern tier of counties in Pennsylvania to determine composition, age relationships, and ecological development. Intensive ecological studies have been made of such remnants of virgin timber as Hearts Content (white pine) and Tionesta (hemlock-hardwoods); 10 acres of sample plots, and several thousand stump sections were examined in Tionesta. Other studies in the Tionesta and Kane Forests have dealt with soil type and forest growth, phenological and climatic observations, the influence of browsing by deer and rabbits on natural reproduction, and common defects of tree species. Already we have (1) better knowledge of silvical requirements, (2) an appreciation of the role of advance reproduction in determining the quality of second and third growth stands, and (3) quantitative data on the effect of certain climatic, soil, and biotic factors.

7. ACCOMPLISHMENTS DURING PAST YEAR:
An article, "Why Timber Stand Improvement", presented data on the common defects of trees in unmanaged stands and stressed the need for proper silviculture to prevent such defects. Weather conditions and damage done by the wide-spread glaze storm of March, 1936, were outlined in two articles, and a study was made to determine the effect of previous cultural treatment on severity of glaze damage. Soils analyses of samples from the Tionesta plots were completed by the Pennsylvania State College. Office counts of all Tionesta tree sections were finished, and progress made in the analysis of results. Preferences of deer and rabbits for local trees and shrubs were published. Weather and phenological observations were continued, and streamflow records on two newly-constructed weirs were begun.

8. PLANS FOR NEXT YEAR:
All information available from this or other phases of the beech-birch-maple-hemlock studies will be compiled and analysed as the basis for a Departmental circular by Forbes and Hough on the silvics and ecology of this type. Current phenological, climatic, and streamflow observations will be continued.

9. DATE OF COMPLETION:
The informal accumulation and compilation of silvical and ecological

information will continue after publication of the 1938 circular, indefinitely. The study of deer and rabbit damage should be completed in about 10-20 years.

10. ASSIGNMENT: R. D. Forbes, A. F. Hough, P. E. Ackerman

RS-AL
Mc-1

April 6, 1938

FINAL CUTTINGS, BEECH-BIRCH-MAPLE-HEMLOCK

1. FIELD DIVISION: Silvics.

2. WORK PROJECT: Silvicultural Investigations

3. FUNCTIONAL PROJECT: Silviculture, Beech-Birch-Maple-Hemlock

4. LINE PROJECT: Final Cuttings

5. PURPOSE OF STUDY:

To determine methods of harvesting mature stands of beech-birch-maple hemlock which will insure satisfactory regeneration. Development of the reserved stand and establishment of natural reproduction are both studied.

6. REVIEW OF PAST WORK:

In 1927 nearly 20 acres of permanent sample plots were established in a timber sale on Little Arnot Creek, Allegheny National Forest, to compare methods of final cutting in a 60-year-old stand of mixed hardwoods, including some older growth. The methods are (1) removal of all trees of sawlog size to a 10 inch d.b.h. limit, (2) selective removal of sawlogs, followed a year later by cutting of about 5 cords of chemical wood per acre, and (3) clear cutting of sawlogs and all chemical wood down to 2 inches d.b.h. The study has shown that growth of the advance understory of seedlings is slow, while seedling sprouts and stump sprouts grow rapidly.

7. ACCOMPLISHMENTS DURING PAST YEAR:

The second remeasurement of the Little Arnot plots was completed and borings were made to determine radial growth before and after the cutting of 1927-28.

A permanent 2-acre plot was established during cutting of culled old-growth beech and sugar maple in Kane Forest. This cutting, which releases an understory of tolerant species fostered by the earlier culling, represents the final cutting of a shelterwood. Logging damage to reproduction, gross and net volume removed as sawtimber and products, and rate of growth of understory before and after cutting will be studied.

The results of clear cutting an immature second-growth stand will be followed on an adjacent plot of 1/2 acre.

8. PLANS FOR NEXT YEAR:

Silvicultural findings from the ten-year-old Little Arnot plots will be published, and establishment reports prepared for the 1937 plots. An effort will be made to interest the Madison Laboratory in undertaking in the Kane Forest a study of methods and costs of logging in the chemical wood industry, in cooperation with the Allegheny National Forest, the Wood Chemical Institute, and local chemical wood manufacturers.

9. DATE OF COMPLETION:

The logging study, if begun in 1938, should be finished in '38 or '39. Tentative information on some matters is already available from the sample plots. Usable answers to some of the main problems are expected within the next 5 or 10 years, but 40 or more years' observation is necessary to final answers.

10. ASSIGNMENT: R. D. Forbes, A. F. Hough, P. E. Ackerman

RS-AL
Mt-1

April 6, 1938

STAND IMPROVEMENT, BEECH-BIRCH-MAPLE-HEMLOCK

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Silvicultural Investigations

3. FUNCTIONAL PROJECT: Silviculture, Beech-Birch-Maple-Hemlock

4. LINE PROJECT: Stand Improvement

5. PURPOSE OF WORK:
To determine the silvicultural practices to be applied in improving the present second-growth stands of the beech-birch-maple-hemlock type of Pennsylvania and Maryland. Present work confined to Pennsylvania

6. REVIEW OF PAST WORK:
In 1933 a heavy thinning on 8 acres of plots (two stands) in Kane Forest removed 10 cords per acre from a 40-year-old stand. Ideal spacing and quality of crop trees was found unattainable in second growth of this age. In 1936 weedings in 13 and 18-year-old stands were made on 19 acres of plots (four stands), using three degrees of release for selected crop trees. Provision was made for later thinning studies. It was evident that weeding is not a cure-all for stands inadequately stocked with crop trees, and that reproduction following clear cutting of immature second growth is usually inferior to that following logging of old growth. Methods of sprout clump reduction to avoid decay were studied in Kane Forest by Dr. Campbell of the B.P.I.

7. ACCOMPLISHMENTS DURING PAST YEAR:
Four quarter-acre plots were established to study mowing-back of two size classes of advance seedlings in all-aged old growth stand on Kane Forest. Simple treatments to reduce stump sprouting of black cherry were explored; a brushing back of sprouts during the summer following cutting discouraged sprouting in 68 percent of all stumps examined on a recently cut power line. A study of pruning methods was begun with selected crop trees of 5 hardwood species. Permanent plots or strips to study the residual stand and reproduction after sanitation and salvage cuttings of glaze-damaged trees were established.

8. PLANS FOR NEXT YEAR:
Establishment reports on 1937 studies will be written, and preliminary results released.

9. DATE OF COMPLETION:
Results from the stump treatments, mowing, and perhaps from the weeding study should be available in 5 to 10 years. Other studies, and the thinning work on the weeding study, will continue until stand maturity and final results will be available in 40-80 years.

10. ASSIGNMENT: R. D. Forbes, A. F. Hough, P. E. Ackerman

RS-AL
Fp-1, Special

April 7, 1938

SPECIAL CCC STUDY, FOREST PLANTING IN NORTHERN HARDWOOD TYPE

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Regeneration investigations

3. FUNCTIONAL PROJECT: Regeneration, beech-birch-maple-hemlock

4. LINE PROJECT: Planting, beech-birch-maple-hemlock

5. PURPOSE OF WORK:
   To provide information needed in establishment of successful forest plantations in the northern Allegheny Plateau, particularly in the aspen-bird cherry sub-type of the beech-birch-maple-hemlock type.

6. REVIEW OF PAST WORK:
   A cooperative study with R-7. During 1936 Junior Forester Hetzel examined over 1000 temporary plots, in plantations 3 to 10 years of age in Allegheny National Forest and adjacent private land, following a working plan prepared at the Station.

7. ACCOMPLISHMENTS DURING PAST YEAR:
   Hetzel completed a manuscript report on his work. Spruce, red pine, and Scotch pine were recommended for progressively drier sites. Red oak was considered successful, but white ash, larch, and white pine were not. Frost heaving is a severe local problem. Hetzel's field data was slightly strengthened by the Station's collection of a few more plots.

8. PLANS FOR NEXT YEAR:
   Test plantations of various size and age classes of stock will be made in cooperation with several agencies.

9. DATE OF COMPLETION:
   If necessitated by lack of funds after July 1, 1938, follow-up to be done by cooperating agencies.

10. ASSIGNMENT: C. E. Ostrom, CCC

RS-AL
Fp-1

April 7, 1938

SOURCE-OF-SEED PLANTATIONS, RED PINE

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Regeneration investigations

3. FUNCTIONAL PROJECT: Regeneration, beech-birch-maple-hemlock

4. LINE PROJECT: Planting, red pine

5. PURPOSE OF WORK:
   To determine, in cooperation with the Lake States Experiment Station, the adaptability to the conditions of the northern Allegheny Plateau of red pine from nine seed source regions (Lake States to New England).

6. REVIEW OF PAST WORK:
   4-1/2-acre planting site prepared by CCC in 1933-36.

7. ACCOMPLISHMENTS DURING PAST YEAR:
   In May 50 lots of 100 transplants each, raised by the Lake States Station, were planted. At end of growing season growth was better than average for the more southerly Lake States strains, and poorer than average for the northern Minnesota and northeastern United States strains.

8. PLANS FOR NEXT YEAR:
   Re-examine plantation at least at end of growing season. Short note on first year's indications.

9. DATE OF COMPLETION:
   Not less than 40 years.

10. ASSIGNMENT:
    Hough, Ackerman

RS-AL
Fs-1

April 7, 1938

SEED STORAGE AND TREATMENT, BLACK CHERRY

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Regeneration Investigations

3. FUNCTIONAL PROJECT: Regeneration, beech-birch-maple-hemlock

4. LINE PROJECT: Seed, black cherry

5. PURPOSE OF WORK:
   To determine the effect of different storage conditions and seed treatments on germination of black cherry.

6. REVIEW OF PAST WORK:
   Stratification was found to be necessary for good germination; the effect of other treatments was not marked.

7. ACCOMPLISHMENTS DURING PAST YEAR:
   An experiment was begun with heating and pulping treatments of ripe and unripe seed.

8. PLANS FOR NEXT YEAR: Follow-up of tests now under way.

9. DATE OF COMPLETION: 1939.

10. ASSIGNMENT: A. F. Hough

RS-AL
Pf-3

April 6, 1938

EFFECTS OF FIRE - OAK-PINE TYPE

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Fire protection, oak-pine

3. FUNCTIONAL PROJECT: Fire protection, oak-pine

4. LINE PROJECT: Effect of fire, oak-pine

5. PURPOSE OF WORK:
   To determine both the harmful and beneficial effects of fire on the forest and site in the oak-pine type of New Jersey, Delaware, and Maryland. At present includes damage from both accidental and "controlled" fires, and the possible beneficial effects, in southern New Jersey.

6. REVIEW OF PAST WORK:
   Study of damage to the forest made following the spring fires of 1930, data from which were published in 3 articles.
   State Forester urgently requested our help in "controlled burning" experiment on sixteen 5-acre blocks, to be burned carefully at varying annual periods. Block establishment begun by the CCC in 1936.

7. ACCOMPLISHMENTS DURING PAST YEAR:
   The following 1/20 acre plots were established:
   160 (140 burned - 20 controls) in the oak-pine type - without pretreatment (i.e. without mowing and burning the underbrush). Controlled burning experimental area proper.
   42 in oak-pine type - pretreated. Safety strips, Lebanon Experimental Forest.
   50 in the lowland pine type - without pretreatment. Private land.
   34 in the lowland pine type - pretreated. Safety strip, Lebanon Experimental Forest.
   From the first group complete data on timber stand, reproduction, and lesser vegetation, as well as fire hazard ratings, were recorded before and after "controlled" burning, and in the other groups after burning only.
   Statistical analysis of damage data from all sets of plots made and summarized in a manuscript showing that damage was light in the oak-pine type, and heavy in the pine type, both regardless of pretreatment. Pine reproduction was scanty following the fire and no more abundant on the burned than on the control plots.

8. PLANS FOR NEXT YEAR:
   The following plots will be reburned, and damage determined: 20 in the controlled burning area, and the 76 in the Lebanon safety strips.
   Pine reproduction will be recorded on 1600 mil-acres in the controlled burning area. Three articles will be prepared for publication.

9. DATE OF COMPLETION:
   Some data on both damage and possible benefits will be completed annually; final results will not be available until 1952.

10. ASSIGNMENT: O. M. Wood

RS-AL
Pf-Special, New Jersey April 6, 1938

SPECIAL CCC STUDY, NEW JERSEY FOREST FIRE BEHAVIOR

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Fire Protection Investigations

3. FUNCTIONAL PROJECT: Fire Protection, Oak-Pine

4. LINE PROJECT: Behavior of fire in New Jersey

5. PURPOSE OF WORK:
To obtain information relative to forest fire behavior, and to determine the effect of various fire control measures on behavior, for the more recent forest fires in New Jersey, by:
1. Analysis of the 1935, 1936, and 1937 forest fire records. Special emphasis will be placed on time, cost, size, and weather relationships.
2. Compiling and analyzing fire behavior records on fires during the 1937 season.
3. Field studies of going fires in the 1938 spring fire season. Emphasis will be placed on fire behavior (i.e. rate of spread) as affected by fuel type, weather factors, and fire control measures.

6. REVIEW OF PAST WORK:
A special project in cooperation with Region 7 of the Forest Service and the New Jersey Forest Fire Service, begun in August, 1936. Tabled temporarily in February, 1937, due to lack of positive interest by New Jersey Forest Fire Service, to the completion of C-M Inspection Report and therefore lack of immediate practical interest on R-7's part, and to lack of man-power. Reinitiated by the Station as a CCC project on November 1, 1937.
Annual fire maps, 1931-1935, showing location and size were completed in cooperation with Region 7. 1936
Charts of fire statistics 1925-1935 1936
Computation of precipitation data 1931-1935. 1936
Preliminary intensive analysis 1931 fire records 1936

7. ACCOMPLISHMENTS DURING PAST YEAR:
Tabulation of fire records 1935-36-37 for punching, partially completed. Punch card sorting and tabulating directions in rough draft. Form for records on going fires developed.

8. PLANS FOR NEXT YEAR:
1. Complete tabulation, punching, and analysis of 1935-36-37 fire records.
2. Obtain information on as many 1937 and 1938 fires as possible in field.
3. Analyze results and write report.

9. DATE OF COMPLETION: June 30, 1938.

10. ASSIGNMENT: G. Luther Schnur, (Silas Little, Jr., E. F. Meyer, CCC), F. H. McClennen.

RS-AL
Mt-3

April 6, 1938

TIMBER STAND IMPROVEMENT, OAK-PINE TYPE

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Silvicultural Investigations

3. FUNCTIONAL PROJECT: Silviculture, Oak-Pine

4. LINE PROJECT: Stand Improvement, Oak-Pine

5. PURPOSE OF WORK:
   To determine the silvicultural practices to be applied in improving the present second-growth stands of the oak-pine type of New Jersey, Delaware, and Maryland. At present includes work in southern New Jersey only.

6. REVIEW OF PAST WORK:
   In 1935 a 4-acre Latin square, having 3 replications of three degrees of thinning and 4 controls, was established in a 13-year-old stand of mixed oak in the Lebanon Experimental Forest. A very light thinning, which also removed dead trees and other inflammable material, was being applied to a similar stand on the adjacent State Forest by the CCC. A strip survey was run through this stand, and promising variations from the marking were decided upon.

7. ACCOMPLISHMENTS DURING PAST YEAR: None.

8. PLANS FOR NEXT YEAR: None.

9. DATE OF COMPLETION:
   The plots will be remeasured for the first time in 1940, and a preliminary analysis of the effect of the cutting will be made. Final results will not be obtainable for 20-30 years.

10. ASSIGNMENT: O. M. Wood

RS-AL
Mt-2, Special, Virginia Pine April 6, 1938

SPECIAL CCC STUDY, THINNING AND PRUNING VIRGINIA PINE IN MARYLAND

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Silvicultural Investigations

3. FUNCTIONAL PROJECT: Silviculture, Oak-Pine

4. LINE PROJECT: Thinning and pruning Virginia pine in Maryland

5. PURPOSE OF WORK:
To demonstrate the effect of pruning and varying degrees of thinning on probable volume and quality of wood production in old field stands of Virginia pine, in Maryland. Includes:
1. Selection, treatment, and measurement of sample plots located in randomized blocks in old field stands of Virginia pine in 10-15, 20-25, and 30-35 year-old stands in the Cedarville State Forest, southern Maryland.
2. Replication of this, if possible, on the Green Ridge State Forest in western Maryland.

6. REVIEW OF PAST WORK:
A special project, in cooperation with the Maryland State Department of Forestry and the CCC, begun in August, 1937.

7. ACCOMPLISHMENTS DURING PAST YEAR:
Reconnaissance survey of Research Center Experimental Forest to determine age, density, and composition of typical Virginia pine stands. Crown and d.b.h. measurements were obtained on 70 open grown trees there, from which theoretical minimum degrees of stocking were computed. Working plan re-written after discussion with cooperating agency.

8. PLANS FOR NEXT YEAR:
Establishment and measurement of about 33 plots on the Cedarville State Forest. Writing of establishment report for at least CCC use, covering value of products removed, time-cost of various operations, and probable value of completed cuttings.

9. DATE OF COMPLETION:
Demonstration phase will be completed by June 30, 1938. If feasible, remeasurement of plots every 5 years until crop rotation age, 40-50 years, or about 1968 for youngest stands; progress reports every 10 years.

10. ASSIGNMENT: G. Luther Schnur (Emil Meyer, Silas Little, Jr., CCC)

RS-AL
ME-3

April 7, 1938

GROWTH AND DEVELOPMENT OF LOBLOLLY PINE STANDS

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Mensuration Investigations

3. FUNCTIONAL PROJECT: Mensuration, Oak-Pine

4. LINE PROJECT: Growth and Development of Loblolly Pine Stands

5. PURPOSE OF WORK:
   To obtain information on rates of growth of loblolly pine, and the laws governing them, in the oak-pine type of Delaware and Maryland.

6. REVIEW OF PAST WORK:
   Begun by Forest Service on private land in 1906. Permanent sample plots remeasured cooperatively by Forest Service and Maryland State Department of Forestry, assigned to Allegheny Station in 1927:
   58 plots loblolly pine established 1906. 55 remeasured . . . 1910
   55 plots remeasured . . . . . 1915. 48 remeasured . . . 1920
   29 plots remeasured . . . . . 1926. 24 remeasured . . . 1930
   13 plots remeasured 1935
   Publication of Bulletin, "Loblolly Pine in Maryland," by Maryland Department of Forestry 1923
   Volume tables prepared by Station from State measurements. . . . 1933
   Diameter distribution of loblolly pine described in Journal of Agricultural Research 1934
   Loblolly pine plot records tabulated and punched on cards. . . . 1934
   Density-Basal area vs. growth, study and publication JAR article. 1935

7. ACCOMPLISHMENTS DURING PAST YEAR: None.

8. PLANS FOR NEXT YEAR:
   Incorporate 1935 plot remeasurements with earlier Maryland data, make any further analyses necessary, and prepare practical article on timber stand improvement practices in loblolly pine. Some administrative planting will be done in Research Center Experimental Forest to provide properly spaced stands for future research.

9. DATE OF COMPLETION:
   Permanent plots established in 1906 to be remeasured every 5 years as long as enough are available to give worth-while information.

10. ASSIGNMENT: G. Luther Schnur

RS-AL
Fp-3

April 7, 1938

INTERPLANTING, OAK-PINE TYPE

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Regeneration Investigations

3. FUNCTIONAL PROJECT: Regeneration, Oak-Pine

4. LINE PROJECT: Planting, Oak-Pine

5. PURPOSE OF WORK:
To determine the silvicultural and economic possibilities of supplementing the present inadequate stocking of Coastal Plain stands in southern New Jersey by interplanting both coniferous and deciduous species in sprout hardwood and pine stands of varying age and density.

6. REVIEW OF PAST WORK:
N. J. has interplanted conifers extensively on State Forests, and has experimented with planting hardwoods in fire breaks. During the years 1930-33 inclusive the Station interplanted over 10,000 coniferous seedlings, of seven species, in 40 acres of a young hardwood coppice stand, thinned and unthinned, and on land cleared of all hardwood growth, at the Camp Ockanickon Experimental Forest. Release cuttings made in 1933. Early results described in two published articles.

7. ACCOMPLISHMENTS DURING PAST YEAR:
Working plan revised to include planting of hardwoods. (1) Over 800 seedlings Quercus alba L., Q. velutina Lam., and Q. montana Willd. 2-0 stock were interplanted on upland soil in plots within the young hardwood coppice stand previously thinned. (2) About 260 seedlings of Acer saccharum, planted in openings in a pitch pine stand on the lowland St. Johns soil. Both plantings at the Lebanon Experimental Forest, N.J. Individual records of growth and survival of the oaks and maples, and of deer damage to the latter, kept during 1937. Data not completely analyzed during 1937; survival of oaks appears good but growth poor. Both survival and growth of maples good, but growth offset by deer browsing. (3) Further release of the pines at Camp Ockanickon made with ERA labor.

8. PLANS FOR NEXT YEAR:
Growth and survival of (1) the oaks and (2) the silver maples at the Lebanon to be followed during the 1939 field season. (3) Missing tree tags to be replaced in the Camp Ockanickon pines.
Proposed publications: Deer damage to the planted silver maples. Technical note.

9. DATE OF COMPLETION:
(1) The success of the oak planting should be known by 1930.
(2) The success of the maple planting will be governed by the amount of deer damage sustained in the future - possibly by 1940 ultimate success of the planting will be known.
(3) The main objective of the pine planting should be attained by 1945.

10. ASSIGNMENT: O. M. Wood

PS-AL
ME-2

April 7, 1938

OAK YIELD STUDY

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Mensuration Investigations

3. FUNCTIONAL PROJECT: Mensuration, Oaks

4. LINE PROJECT: Oak Yield Study

5. PURPOSE OF WORK:
   To provide regional volume, stand, and yield tables, and closely related information, necessary for the management of the upland-oak forest types in the Eastern United States.

6. REVIEW OF PAST WORK:
   Contributions by the Allegheny Station
   - Measurement of 57 yield plots 1927,1928
   - Measurement and volume computation of 1600 trees. 1928
   - Cordwood converting factor study conducted at Westline, Pa. 1928
   - Volume tables for black cherry (computed at Station). . . . 1929
   - Preliminary study of oak cordwood converting factors on the Black Rock Forest, Cornwall, N.Y.. 1929
   - Volume tables for 11 species (computed at Washington, D. C.). 1928-1930
   - Publication, of Pennsylvania State Agricultural Experiment Station bulletin, No. 269. "The Measurement of Mine Props, Linear Foot Top Diameter, Weight and Volume Tables", in cooperation with the Pennsylvania State College. 1931
   - Publication of results of Westline, Pa., cordwood converting factor study, in the Journal of Forestry . . . 1932
   - Stand and yield analyses completed and tables prepared for upland oak types; manuscript submitted for Departmental bulletin 1933
   - Volume tables (45 in number) mimeographed and distributed to several organizations requesting them 1935
   - Analysis comparing volumes of trees of different species in one locality and volumes of like species in different localities 1935
   - Oak yield manuscript given final revision and submitted to the Department for publication as bulletin. . . 1936

7. ACCOMPLISHMENTS DURING PAST YEAR:
   Publication of U. S. D. A. Technical Bulletin #560, "Yield, Stand, and Volume Tables for Even-Aged Upland Oak Forests".

8. PLANS FOR NEXT YEAR:
   Preparation of brief paper on comparison of tree volumes.

9. DATE OF COMPLETION: June 30, 1938

10. ASSIGNMENT: G. Luther Schnur

RS-AL
Mt-Special, White Pine April 6, 1938

SPECIAL CCC STUDY, THINNING AND PRUNING OF PLANTED WHITE PINE IN MARYLAND

1. FIELD DIVISION: Silvics

2. WORK PROJECT: Silvicultural Investigations

3. FUNCTIONAL PROJECT: Silviculture, Oaks

4. LINE PROJECT: Thinning and pruning planted white pine in Maryland

5. PURPOSE OF WORK:
To demonstrate in a 25-year old plantation of white pine and tulip poplar on the Loch Raven watershed of Baltimore, Maryland:
1. The effect of pruning and various degrees of thinning on probable volume and quality of wood production, and on aesthetic values.
a. Three degrees of thinning and no treatment will be compared; 8 replications will be attained by use of two 4 by 4 Latin square arrangements of plots.
b. Pruning vs. no pruning will be compared on each.
2. The relative efficiency and economy of various pruning tools and methods.

6. REVIEW OF PAST WORK:
A cooperative project with the Maryland State Department of Forestry and the CCC. Preliminary field work completed by Maryland CCC in 1936.

7. ACCOMPLISHMENTS DURING PAST YEAR:
About 9 acres of plots established, and all thinning and pruning work completed. Article on pruning phases of work submitted to Journal of Forestry. Volume tables for plantation white pine and yellow poplar distributed as Technical Notes.

8. PLANS FOR NEXT YEAR:
Establishment report for thinning study, and distribution of it and working plan to at least CCC. Tally of all losses in thinned stands, and assignment of cause.

9. DATE OF COMPLETION:
Initial losses due to opening stand completed December 31, 1939.
If feasible, remeasurement of plots every five years until crop rotation age, 60 years, or about 1972; progress reports every 10 years.

10. ASSIGNMENT: G. Luther Schnur (Wm. Mollenhauer Jr., E. F. Meyer, CCC)